AMENDMENT TO THE CLAIMS

A complete list of all the presently or formerly pending claims in the application is provided below, with suitable headings to show the status of each claim.

Please cancel claims 1-6 without prejudice or disclaimer to the subject matter therein.

Claims 1-6 (cancelled)

7. (Currently amended) An electromagnetic tracking system comprising

a magnetic field generating unit having at least one field generating coil driven by a drive signal,

a field sensing unit having at least one field sensing coil generating a sensing signal responsive to a changing magnetic field, said changing magnetic field including a position-dependent field produced by said magnetic field generating unit, the generating and sensing units being arranged to generate and to sense, respectively an electromagnetic field in an arena of interest, and wherein at least one of said units is movable,

signal measurement and conditioning circuitry connected to said units to

(i) synchronously sample and digitize drive signal data and sensing signal data for respective pairs of field generating and field sensing coils, cumulating the digitized data to form a raw signal matrix, and

(ii) determine a mutual inductance matrix from the raw signal matrix, and

a processor that utilizes the mutual inductance matrix to determine coordinates of the moveable unit.

8. (Original) The electromagnetic tracking system of claim 7, wherein the field sensing unit is fixed to a structure and the field generating unit is movable.

9. (Original) The electromagnetic tracking system of claim 7, wherein the processor normalizes the raw signal matrix with respect to drive signal and sensing unit coil coupling response.

10. (Original) The electromagnetic tracking system of claim 8, wherein the processor determines coordinates of the movable unit by approximating coordinates of the field sensing unit relative to the field generating unit, and iteratively adjusting the approximated coordinates to determine coordinates of the movable unit.

11. (Original) The electromagnetic tracking system of claim 7, wherein the drive signal is any of a drive current or a drive voltage.

12. (Original) An electromagnetic tracking system comprising

a magnetic field generating unit driven by a drive signal,

a field sensing unit having a sensing signal responsive to a changing magnetic field, said changing magnetic field including a position-dependent field produced by said magnetic field generating unit,

the generating and sensing units being arranged to generate and to sense, respectively, an electromagnetic field in an arena of interest, and wherein at least one of said units is movable,

signal measurement and conditioning circuitry connected to said units to sample and digitize signal data for the field generating and field sensing units,

a distorter having a known structure disposed at a selected location in the arena of interest, and

a processor operative on the sampled and digitized signal data to determine relative coordinates and orientations of said field generating or field sensing unit, said processor modeling the distorter and the generating and sensing units to generate modeled signal data and fitting said modeled signal data to measured signal values to determine coordinates and orientations of said field generating and field sensing units.

13. (Currently amended) An electromagnetic tracking system comprising

a magnetic field generating unit and a magnetic field sensing unit, at least one of said units being movable relative to the other, the sensing unit having a sensing signal responsive to a changing magnetic field produced by said magnetic field generating unit, the generating and sensing units being arranged to generate and to sense, respectively, an electromagnetic field in an arena of interest,

signal measurement and conditioning circuitry connected to said unit to sample and condition field generating and field sensing signal values,

a processor operative on sampled and conditioned signal values to determine relative position and orientation of said units,

wherein the signal measurement and conditioning circuitry includes a common gain stage amplifier connected to plural coils and a high precision analog to digital converter that converts amplified coil signals to high precision digital values such that coil outputs over a work arena may be digitally processed without patching or conversion of gains in different regions of the work arena.

14. (Currently amended) An intra-operative imaging and tracking system for guiding a surgical tool during a surgical procedure performed on a patient, comprising

a fluoroscope having an x-ray source and an imaging assembly, said source and imaging assembly being movable about the patient to generate a plurality of two-dimensional x-ray images of the patient from different views,

a magnetic tracker having a field generating unit driven by a drive signal to generate an electromagnetic field in an arena of interest and a sensing unit that generates a sensing signal in response to said field, one of said units being secured against movement relative to said imaging assembly and the other unit being affixed to the surgical tool,

a magnetic field distorter secured against movement relative to said imaging assembly,

a signal measurement circuit for measuring said drive and sensing signals to generate measured signal data, and

a processor operative on said x-ray images and said ~~measure~~ measured signals, said processor modeling said field distorter and said generating and sensing units to derive modeled signal data and fitting said modeled signal data to said measured signal data to determine relative coordinates and orientations of said generating and sensing units, said processor further utilizing said x-ray images and said relative coordinates and orientations to determine a position of the tool relative to the patient.

15. (Currently amended) An intra-operative imaging and tracking system for guiding a surgical tool during a surgical procedure performed on a patient, comprising

a fluoroscope having an x-ray source and a detector, said x-ray source ad detector being movable relative to the patient so as to generate a plurality of two-dimensional x-ray images of the patient from different views,

a magnetic tracker having a magnetic field generating unit driven by a drive signal to generate an electromagnetic field in an arena of interest and a magnetic field sensing unit generating a sensing signal in response to the electromagnetic field, one of said units being secured against motion relative to the detector and the other unit being affixed to the surgical tool,

[[a]] signal measurement circuitry electrically coupled to the tracker to measure said drive and sensing signals to form a matrix representing mutual inductance between said generating and sensing units, and

a processor operative with said mutual inductance matrix and said x-ray images to determine coordinates of the unit affixed to the surgical tool and position of the surgical tool relative to the patient.

16. (Currently amended) An electromagnetic tracking system comprising

a magnetic field generating unit driven by a drive signal,

a field sensing unit having a sensing signal responsive to a changing magnetic field, said changing magnetic field including a position-dependent field produced by said magnetic field generating unit,

the generating and sensing units being arranged to generate and to sense, respectively, an electromagnetic field in an arena of interest, and wherein at least one of said units is movable,

signal measurement and conditioning circuitry connected to said units to sample and digitize signal data for the field generating and field sensing units,

a distorter having a structure optimal for shielding one or more objects in the arena of interest, said ~~distorted~~ distorter being disposed so as to substantially shield magnetic fields generated by said objects, and

a processor operative on the sampled and digitized signal data to determine relative coordinates and orientations of said field generating or field sensing unit, said processor modeling the distorter and the generating and sensing units to generate modeled signal data and fitting said modeled signal data to measured signal values to determine coordinates and orientations of said field generating and field sensing units.